



## The Effect of Railway Noise on the Residents of Moghbazar Area

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### ARTICLE INFORMATION

Received: January 15, 2023  
Revised: February 15, 2023  
Accepted: February 20, 2023  
Published online: May 16, 2023

**Keywords:**  
railway noise  
impact on health  
noise barriers  
ambient noise  
noise level

### ABSTRACT

*One of the most damaging pollutions is noise pollution. Dhaka city's uncontrolled noise has rendered its residents in serious and vulnerable situations. Especially in the mixed-use areas noise pollution level and intensity are often higher. Traffic congestion has been recognized as the root cause of the noise, even though railway noise has been an issue nowadays because of the increase in the frequency of use. Hence, this paper is going to investigate and understand the nature and vulnerability of rail noise on the residential people living in mixed-use zone. For which, residences along Moghbazar rail crossing are taken as a study area and a thorough assessment of the problems of noise pollution is conducted. By using a sound level meter, data is collected. The data showed the noise level of the rooms closer to the track remained above 75dBA on average during the daytime in all three points which is 15dBA higher for the day according to Noise Pollution (Control) Rules, 2006, in Bangladesh. Subsequently, a survey is conducted among the people living in these buildings to know the people's perception of rail noise pollution and the detrimental effect on their health. According to the results, most of the occupants are not aware of the adverse effects of noise pollution. The government and local authorities or the residents have not considered the noise of the railways to be of particular concern, although it is a potential source of daily noise. Through research, it is evident that it poses a threat to the inhabitants of the area. As this increased concern for rail noise has not been addressed by any major approach yet. Thus, an alternative way of reducing noise from rail transport by using noise barriers is discussed and suggested as a possible solution.*

### 1. Introduction

Noise is an intolerable level of sound that causes annoyance, physical and mental stress and serious health problems. Any sort of unwanted sound is considered as noise. Noise pollution is an alarming problem in Southeast Asia. The main concern with noise pollution is largely because of the growing variety of individuals exposed to high noise levels. Nowadays, noise pollution is no longer confined to industrial environments but has a global impact on cities and urban areas. Like all other major urban cities in developing nations, noise pollution is a major problem in Dhaka city.

Vehicular transportation is a dominant aspect of various causes of noise pollution. Among them, railroads are one of the major sources of noise pollution that has a significant impact on the environment and the ecosystem.

Railway transportation is the second mainland-based transport mode in Bangladesh after road transport. Comparatively, railroads are more environmentally efficient than road transport, due to less greenhouse gas emission, less fuel consumption and less land use per unit of operation (Final Report on Updating Railway Master Plan, 2017). Thus, the use of railroads has increased over the years. Some of the major factors contributing to the increasing use of railway locomotives are: i) Relatively less travel cost ii) time-saving iii) less distance travelled iv) safer mode of transport v) comfort.

The major problem occurs when the frequent use of railway travel it generates a lot of noise. Along with improved train engines, the speed of movement has increased and noise pollution has been amplified (Bazaras and Rutka, 2002). Train noise depends on the type and condition of the train, the rail, the speed of the train and

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This article is published with open access at [www.seu.edu.bd/seuja](http://www.seu.edu.bd/seuja)  
ISSN No.: 2789-2999 (Print), ISSN No.: 2789-3006 (Online)

the motion scheduled. The noise level also relies on the rotation of wheels as well as the movement between the railway track (Vér and Beranek, 2006). Apart from that frequent use of train horns on the junction points intensifies the level of rail noise in the residential buildings. As a result, the inhabitants are exposed to rail noise every time the train passes. Exposure to such elevated levels of noise can lead to serious auditory stresses, fatigue, reduced attention level, slow psychological responses, and wear of the nervous system, particularly for children and older people. Even though the railways are a daily potential noise source, the government and the people do not consider the noise to be a particular concern. This growing concern about rail noise is not yet addressed with a major approach (Anwari and Hoque, 2016). Hence, this study focuses on the inhabitants of the Moghbazar rail-crossing area to assess the level of noise they are exposed to, people's perceptions, and their awareness of health-related problems. A field survey is carried out to investigate the sources, effects, reactions, and suggestions for controlling excessive noise. In this context, the use of a noise barrier as a passive noise-damping technique is suggested as a feasible solution.

## 2. Literature Review

Railway-induced noise has a long-lasting effect on human beings. It adds to the increase in ambient noise from multiple sources in public locations, (such as industrials, constructions, noisy instrumental tools, generators, loudspeakers, vehicle horns, other mechanical tools, etc.) and has shown deleterious impacts on human health and psychological well-being. According to the World Health Organization (WHO), approximately 5% of the world's population faces various health risks as a result of the complexities associated with noise pollution. Research done by the Ministry of the Environment (DoE) shows noise pollution is becoming a major issue in Bangladesh, particularly in the capital, Dhaka, with sound concentrations far beyond the acceptable rates of noise for the human ear. It conducted a noise pollution survey in Dhaka City at 70 points. The outcome is alarming. The amount of noise in many locations is as high as 120-130 decibels (dB) which is twice higher than the standard level. Research undertaken in 2017 shows that approximately 11.7% of the inhabitants in Bangladesh have lost their hearing because of noise pollution. It means one-tenth of the city's inhabitants have hearing impairments and 35% have multiple types of hearing difficulties. There are millions of individuals with either permanent or partial hearing loss (The Daily Star, 2017). As stated by the World Health Organization (WHO), exposure to a noise level of 60 decibels (DB) can cause temporary deafness and 100 DB can cause permanent deafness (Shila, 2017).

### 2.1. Noise Standards

Table 1: Noise pollution (control) rules, 2006, The Government of the People's Republic of Bangladesh

AREAS	DAY-TIME LIMIT dB(A) (6:00 AM- 9:00 PM)	NIGHT- TIME LIMIT dB(A) (9:00 PM- 6:00 AM)
QUIET AREAS	50	40
RESIDENTIAL AREAS	55	45
MIXED-USE AREAS	60	50
COMMERCIAL AREAS	70	60
INDUSTRIAL AREA	75	70

### 2.2. Problems identified as a source of railway noise

To identify the source of the railway noise, at least six co-determinants are stated, which should be taken into consideration when evaluating noise problems caused by rail noise: i) ground-based vibrations, ii) the distance between residential buildings and railroad tracks, iii) the type of construction of the building, iv) the relationship between passenger trains and freight trains, v) the relationship between standard passenger trains and railroads. (Guski, Schreckenber and Schuemer, 2017) vi) the number, configuration, and speed of trains using the railway; (vii) horn usage by trains; and (viii) other sources of ambient noise, including road-traffic noise, general community noise, industrial noise and noise from birds and insects. (BAN: Railway Sector Investment Program — PFR2 Rehabilitation of Yards and Extension of Loops at Different Stations in Darsana — Ishurdi — Sirajganj Bazar Section, 2011)

The weather conditions also have a major part to play in rail noise propagation. This applies to a range of 100 meters but the noise may be absorbed in small portions from different layers of air. Moisture content in the air generally has a better possibility of spreading the noise further than dry air. The wind also has a significant effect on the propagation of noise which increases in speed with the height gained above the ground (Hranický, Kendra and Skráčany, 2016).

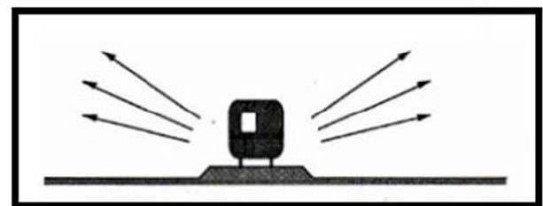


Figure 1: In normal conditions the propagation of noise (source: Hranický, Kendra and Skráčany, 2016)

In figure.1: The sound extends radially from the source of noise under normal circumstances. If the train at ground level is considered a source of noise, noise extends laterally and upward direction diagonally.

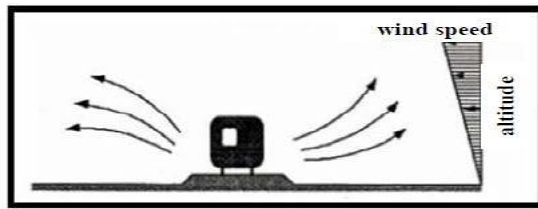


Figure 2: The propagation of noise with the wind (source: Hranický, Kendra and Skrúcaný, 2016)

Figure 2 shows: Higher wind speed tends to rotate noise rays going upwind upwards. Likewise, the sound from the other side of the train is distributed to the ground in the same direction as the wind flow. This can ultimately result in a significantly lower noise level at the same distance from the path on the wind side than on the lean side of the path. This can ultimately result in at the same distance from the track on the windward side having a significantly lower noise level than on the lean side of the track.

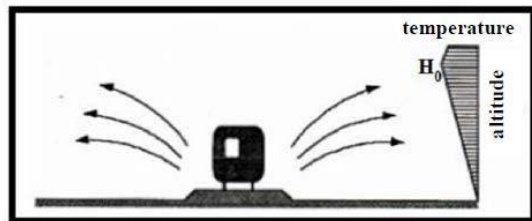


Figure 3: Noise propagation with weather changes (source: Hranický, Kendra and Skrúcaný, 2016)

In Figure: 3 Temperature reduces with rising altitude under normal weather conditions. This leads to sound waves bending up. During winter the temperature gradient is rotated and the ground temperature is lower so the direction of sound propagation tends to rotate back to the surface. The wind speed and direction can influence sound propagation and value in individual sites considerably. Studies on traffic noise at a certain location must, therefore, consider not only the present weather conditions but also the long-term conditions including frequent rainfall and wind breezes. (Hranický, Kendra and Skrúcaný, 2016)

### 3. Methodology

To assess railway noise in Dhaka city, the Moghbazar rail crossing area was selected as a study area. Moghbazar rail line is considered as one of the hectic railroads of the city. Three points A, B, and C are selected where three residential buildings are taken as a study case to assess the noise level of the passing trains. Data collected by the sound level meter is analysed and compared against the allowable upper limit of the outdoor noise levels from table.3. The most affected spaces on each building are

shown on their respective plans. A fieldsurvey of the respective buildings with survey questions for the dwellers is set to evaluate the existing perception and impact of the railway noise.

#### 3.1. Study Area

Moghbazar rail crossing is a mixed-use area. A radius of 500m (782,000 sqm approx.) is taken for the study area which has mostly residential buildings constructed along the rail tracks with one mosque and community hospital beside the trail and several around the areas in proximity to the track. The track is considered as one of the busiest rail junctions, where more than 25-30 trains cross daily on average and on special occasions such as Eid the limit crosses up to 40 trains. As the area is densely populated, pedestrians use the space along the track for various purposes such as temporary teastalls, slums, Kacha bazaar, etc. It can be observed that a lot of people are found on the rail tracks during the day, for which the trains use loud horns to make the people alert and avoid accidents in the line. Thus, these factors contribute to intensifying railway noise. In points A, B and C three residential buildings are surveyed and the noise level generated inside for each of the residences is noted.

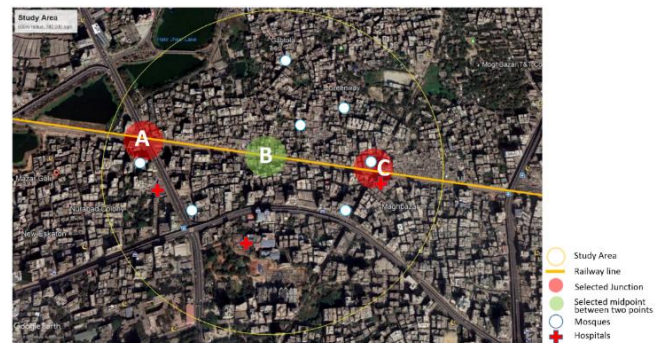
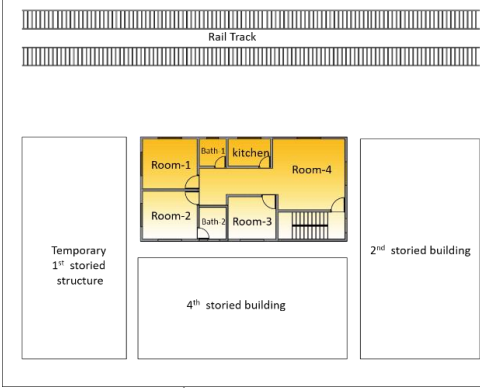
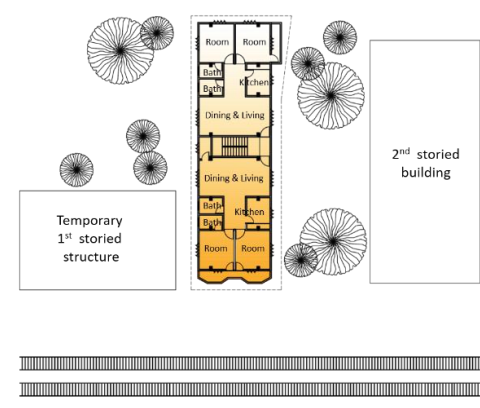
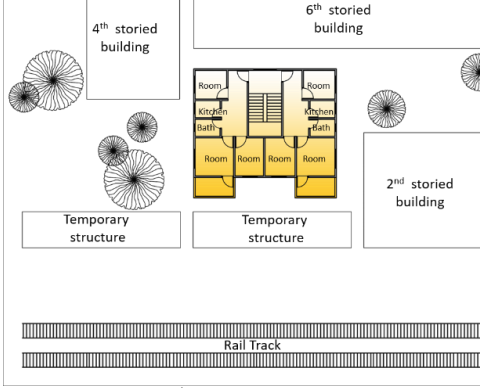


Figure 4: Map showing the study area with two selected junctions (Source: Google Earth)

#### 3.2. Parameters set for collecting data for measuring the noise level

- The residence chosen is within 20ft of the three junction points. Junction points located in the map are on the roads: Shaheed Tajuddin Ahmed Avenue Road, Pearabagh Road, Wireless Rail Gate
- The distance between the Rail Track and the buildings is 20-30 ft
- The data was collected during working days (Sunday for POINT A, Monday for POINT B, Tuesday for POINT C)
- The data is collected from the second floor of the respective buildings and the data logger was placed in the room which is the nearest to the track.

Table 2: Data logged from the three points

<p style="text-align: center;"><b>POINTS</b></p> <p style="text-align: center;">exposure to the noise level according to the spaces in plan</p> <div style="display: flex; align-items: center;"> <div style="width: 15px; height: 15px; background-color: yellow; margin-right: 5px;"></div> <div> <p>High</p> <p>Medium</p> <p>Low</p> </div> </div>	Residential Building Details	Train time recorded (9am-3pm)	Average reading recorded (dBA)	Maximum reading recorded (dBA), (due to horn)
 <p style="text-align: center;">↑ POINT A</p>	<p><b>Location:</b> Near Shaheed Tajuddin Ahmed Avenue Road(Main Road)</p> <p><b>Distance from the track:</b> 20 ft</p> <p><b>Floors:</b> G+5</p> <p><b>Floor area:</b> 960 sft</p> <p><b>Units:</b> 1</p>	<p>09:15 am</p> <p>10:24 am</p> <p>11:19 am</p> <p>12:55 pm</p> <p>01:08 pm</p> <p>01:35 pm</p> <p>02:05 pm</p> <p>02:48 pm</p>	<p>76.82</p> <p>78.35</p> <p>71.85</p> <p>76.43</p> <p>83.58</p> <p>81.58</p> <p>74.95</p> <p>73.55</p>	<p>82.25</p> <p>84.57</p> <p>78.69</p> <p>85.89</p> <p>90.73</p> <p>88.15</p> <p>79.42</p> <p>77.31</p>
 <p style="text-align: center;">↑ POINT B</p>	<p><b>Location:</b> Near Pearabagh Road (Secondary Road)</p> <p><b>Distance from the track:</b> 20 ft</p> <p><b>Floors:</b> G+3</p> <p><b>Floor area:</b> 1660 sft</p> <p><b>Units:</b> 2</p> <p><b>Each Unit:</b> 800 sft</p>	<p>09:05 am</p> <p>10:24 am</p> <p>11:19 am</p> <p>12:55 pm</p> <p>01:08 pm</p> <p>01:35 pm</p> <p>02:05 pm</p> <p>02:48 pm</p>	<p>72.58</p> <p>75.24</p> <p>74.76</p> <p>68.96</p> <p>65.75</p> <p>77.32</p> <p>71.27</p> <p>73.15</p>	<p>78.58</p> <p>80.97</p> <p>78.49</p> <p>75.71</p> <p>72.13</p> <p>84.52</p> <p>78.27</p> <p>77.14</p>
 <p style="text-align: center;">↑ POINT C</p>	<p><b>Location:</b> Near Wireless Rail Gatemain Road)</p> <p><b>Distance from the track:</b> 30 ft</p> <p><b>Floors:</b> G+3</p> <p><b>Floor area:</b> 1250 sft</p> <p><b>Units:</b> 2</p> <p><b>Each Unit:</b> 625 sft</p>	<p>09:19 am</p> <p>09:37 am</p> <p>10:57 am</p> <p>10:26 am</p> <p>11:41 am</p> <p>01:16 pm</p> <p>02:18 pm</p> <p>02:54 pm</p>	<p>71.85</p> <p>68.15</p> <p>73.26</p> <p>79.19</p> <p>75.78</p> <p>77.10</p> <p>82.96</p> <p>76.54</p>	<p>78.35</p> <p>75.20</p> <p>79.85</p> <p>85.85</p> <p>82.14</p> <p>86.85</p> <p>88.74</p> <p>81.94</p>



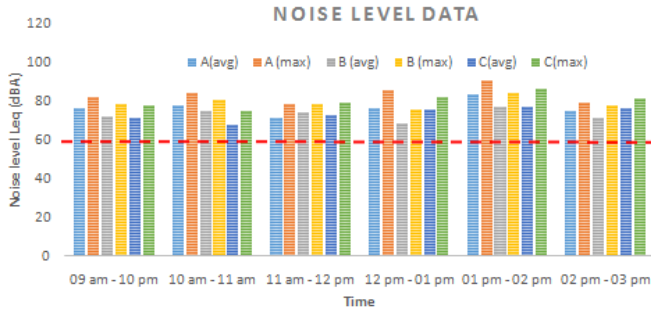


Figure 5: Graphical presentation of data  
The red line indicates the acceptable noise limitation set by the noise pollution (regulation and control) rules, 2006 for Day

Table 3: Equivalent Noise Exposure Level

Point	Exposure time (Hours)	Equivalent noise exposure level (Lex)
A	1.30	78.8 dBA
B	1.30	73.5 dBA
C	1.30	76.2 dBA

### 3.3. Comparing junction points A, B, C

Figure 5 demonstrates the intensity of noise level from (9 am to 3 pm) of the day at all three selected points. The rail track on Point A and Point C is connected with the main road, as a result, it has a high and low label of ambient noise so when the train passes it adds to the noise level intensifying it. Even though the noise level of the train remains mostly constant but it spikes due to the frequent and vigorous use of train horns as it arrives at the junctions, this causes an escalation in ambient noise in the indoor environment from 85~90dB. Whereas on Point B the noise level is lower as it is a secondary road the ambient noise is comparatively lower than the main roads but it still faces the same problem of increase in noise level due to the use of horns. More than 30 trains (approximately) cross points A, B, and C in a single day. Therefore, on a daily basis the noise exposure level of the occupants is above 76 dBA on average which is 16 dBA higher than the noise limit.

### 3.4. Data Collection and Analysis for the Survey

Along the Moghbazar railline, a questionnaire survey was conducted in the surveyed buildings of points A, B and C to better understand the current scenario of the noise pollution issue from the people living there. Apart from that peoples' perception of the current noise pollution and the related health problems they are facing are also noted. This questionnaire included five sections; (1) socio-demographic information; name, age, gender, the status of education, and occupation (2) impacts of railway noise in their daily life (3) if they are facing any health

issues (4) their perception on using noise barrier (5) suggestions from the people (optional). Due to the variations in features, preferences, and views, the participants were split into residents (mainly housewives) and working groups (job-holders). A total of 15 people is surveyed, 5 from each building from the three points. Out of which 5 housewives, 3 elderly people, 4 job holders, and 3 students are present. Oral feedback is noted on the survey questionnaire paper.

According to the survey, 60% of the inhabitants considered railway sound as a part of their daily life and they showed little or no concern about it. Even though 20% are aware of it as noise pollution which mostly includes students and housewives but the elderly people barely see it as a serious problem.

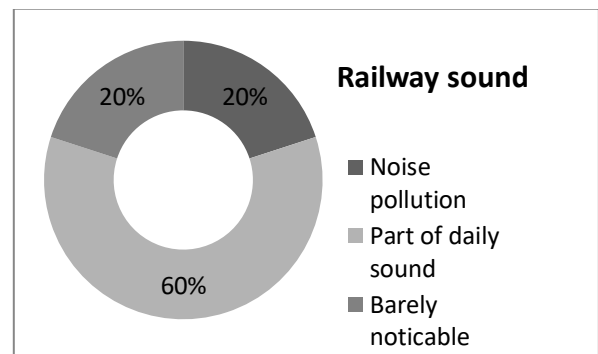


Figure 6: Survey question data (question-1)

Among the participants, 67% think vehicular noise (automobile) is the main source of active noise, whereas people who lived more than 10 years onwards (20%) besides the tracks blamed the railway locomotive horn as the most irritating noise.

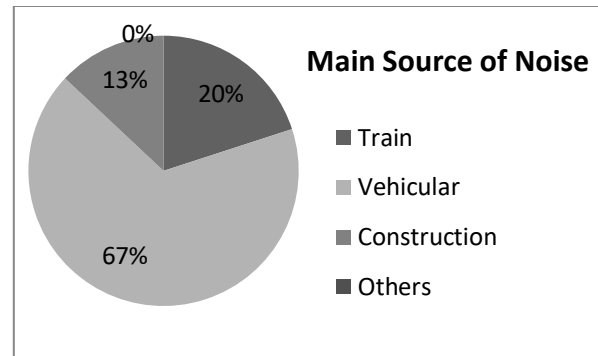


Figure 7: Survey question data (question-2)

Residents who live there for a maximum of the day especially housewives and elderly persons are the main sufferers than the job holders because 40% said that it was intolerable in the beginning but with time it became barely noticeable, whereas 27% found it painful in the beginning (especially the train horn) but it is acceptable for them now. Thus, in the data, it is evident that the adaptability of people to become used to noise pollution increases with time.

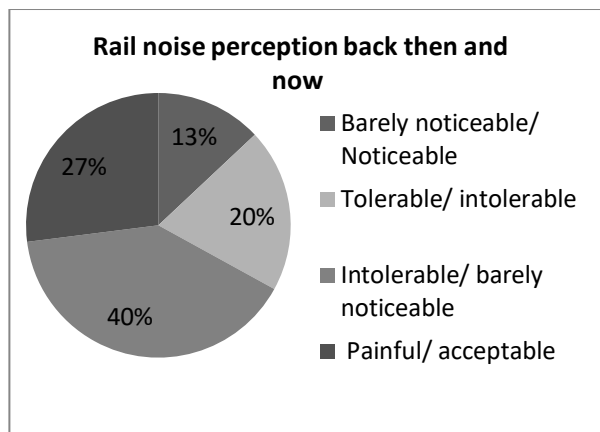


Figure 8: Survey question data (question-4)

According to the data, 80% of the respondents accused that the train noise disrupts them at night, as a result, it gets harder for them and their kids to go to work and school in the morning and only 20% chose other options (morning, afternoon and evening).

Unfortunately, 44% of the respondents are not even aware of the health hazards caused due to rail noise pollution. Although the probability of hearing loss is more for participants living more than 10 years, many of them denied or got offered while answering it, only 13% admitted to having less auditory capacity. 40% agreed with headaches as a health problem which is caused due to the propagation of noise, 27% lost their control of temper, 13% had high blood pressure and others admitted to having trouble concentrating on work.

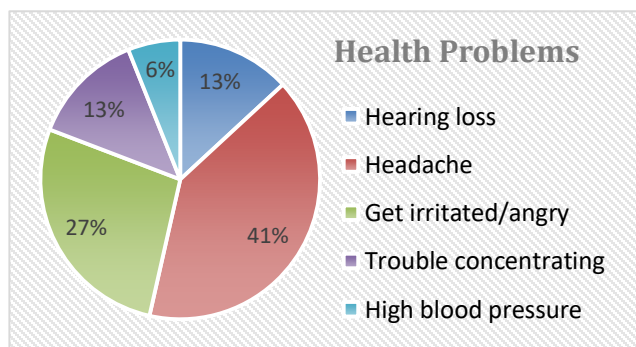


Figure 9: Survey question data (question-6)

The use of a noise barrier was explained to the participants before asking questions related to it. After this the majority (53%) showed mixed feelings towards using this barrier for passive noise reduction, 20% (especially the housewives) agreed on the construction noise barrier and 27% disagreed with using it as they feel it is going to be a waste of money. From the survey data, it is evident that both in the short- and long-term rail noise has a significant negative impact on people and many people fail to recognize it as a threat.

#### 4. Results and Observation

The rail noise attenuates as the distance from the railline increases because the buildings next to the line act as a noise wall itself. The people who are seriously affected by the noise are the residents who live next to the track. Within a floor plan, the spaces which are next to the track are more susceptible and exposed to noise pollution than the ones which are further. Women (especially housewives) and elderly people are prone to disease-related noise pollution. The adverse effects of rail noise on heart patients and children are exacerbated. Children and heart patients are particularly susceptible to stress caused by noise (Berglund, Lindvall and (Eds.), 1995). The worst fact is that noise pollution passively kills people internally and does not make them aware of this problem. Long-term exposure to rail noise has a drastic effect on human well-being.

One of the major reasons for rail noise is using horns. Trains use horns during the day but it increases their frequency of use at night and during peak hours on arrival to the junction points. For which at night, the ambient noise is low which amplifies the sound of the train horn hence disrupting sleep causing irritation, insomnia, etc. According to the engine driver, the reason for using the horn is that the local people use the train tracks as a pedestrian walkway, many motorbike users use the side lane as a shortcut road, and various types of temporary structures such as tea stalls, grocery shops, slums, etc. are built along the line, this increases the chance of accidents on the train track so as precaution horns are used.



Figure 8: Existing condition of Moghbazar Rail-line

#### 5. Conclusion

Rail noise pollution is becoming more prevalent in Dhaka city with increasing industrialization and urbanization. This paper aimed to show the current condition and vulnerability of noise pollution for the residents of the Moghbazar rail crossing area. Although the rail noise level fluctuates during the day and night, it remains harmful. Railway noise pollution is a neglected issue as it is overshadowed by vehicular noise. Prolongating oneself unknowingly to harmful noise can be detrimental to health and can have physical and psychological effects.

The data showed at junction points A and C the noise limits are higher due to the propagation of ambient road noise. If the additional use of train horns is reduced by protecting the lines it can successfully decrease the rail

noise by 5~10 dB from the current condition.

A noise barrier is a feasible way to reduce the negative effect of sound. It can be successfully installed along the track as there are sufficient spaces beside it. It will not only help to decrease the noise level but also restrict pedestrians and other movements in the track, making it safer and limiting train horn use. However, only awareness is not enough, the government and the residents of the area should be proactive in taking steps to abate the problem.

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